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| 10/799,146 | 03/12/2004 | Yuxiang May Wang | 008244/DSM/BCVD | 7933 |
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| PATTERSON & SHERIDAN, LLP 3040 POST OAK BOULEVARD, SUITE 1500 HOUSTON, TX 77056 | | | HARRISON, MONICA D | |
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DATE MAILED: 07/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/799,146

Applicant(s)

WANG ET AL.

Examiner

Monica D. Harrison

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 March 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-37 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

1. Applicant's amendment filed 3/27/06 has been entered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-6, 8-14, 16-24, 26-31 and 33-37 are rejected under 35 U.S.C. 102(e) as being anticipated by Huang et al (US 2004/0072430).

2. Regarding claim 1, Huang et al discloses a method for processing a substrate in a processing chamber comprising: positioning the substrate in a processing chamber (Figure 3, reference 306); introducing a processing gas into the processing chamber, wherein the processing gas comprises one or more hydrocarbon compounds without containing silicon and an argon carrier gas (pg.7, paragraph 0067); generating a plasma of the processing gas by applying power from a dual- frequency RF source (pg.5, paragraph 0051); and depositing an amorphous carbon layer consisting essentially of hydrogen and carbon on the substrate (pg.5, paragraph 0048).

3. Regarding claim 2, Huang et al discloses further comprising etching the amorphous carbon layer to form a patterned amorphous carbon layer (pg.5, paragraph 0054).

4. Regarding claim 3, Huang et al discloses wherein the one or more hydrocarbon compounds have the general formula C_xH_y , wherein x has a range of 2 to 4 and y has a range of 2 to 10 (pg.5, paragraph 0054).

5. Regarding claim 4, Huang et al discloses wherein the one or more hydrocarbon compounds are selected from the group consisting of propylene (C_3H_6), propyne (C_3H_4), propane (C_3H_8), butane (C_4H_{10}), butylene (C_4H_8), butadiene (C_4H_6), acetylene (C_2H_2), and combinations thereof (pg.5, paragraph 0054).

6. Regarding claim 5, Huang et al discloses removing the amorphous carbon layer from the substrate using a hydrogen-containing plasma, an oxygen-containing plasma, or combination thereof (pg.4, paragraph 0048).

7. Regarding claim 6, Huang et al discloses wherein the generating the plasma comprises applying a first RF power at a first frequency and applying a second RF power at a second frequency less than the first frequency (pg.5, paragraph 0051).

8. Regarding claim 8, Huang et al discloses wherein the ratio of second RF power to first RF power is less than about 0.6:1 (pg.5, paragraph 0051).

9. Regarding claim 9, Huang et al discloses a method for processing a substrate in a processing chamber, comprising: forming a dielectric material layer on a surface of the substrate (Figure 4, reference 408); depositing one or more amorphous carbon layers consisting essentially of hydrogen and carbon on the dielectric material layer by a process comprising (pg.4, paragraph 0048): introducing a processing gas comprising one or more hydrocarbon compounds without containing silicon and an argon carrier gas (pg.6, paragraph 0057; pg.7, paragraph 0067); generating a plasma of the processing gas by applying power from a dual-frequency RF source (pg.5, paragraph

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0051); etching the one or more amorphous carbon layers to form a patterned amorphous carbon layer (pg.5, paragraph 0054); and etching feature definitions in the dielectric material layer corresponding to the patterned one or more amorphous carbon layers (pg.5, paragraph 0054).

10. Regarding claim 10, Huang et al discloses removing the one or more amorphous carbon layers (pg.4, paragraph 0048); and depositing a conductive material on the surface of the substrate (pg.7, paragraph 0076).

11. Regarding claim 11, Huang et al discloses depositing an anti-reflective coating on the one or more amorphous carbon layers; and patterning resist material on the anti-reflective coating; and etching the anti-reflective coating prior to or concurrent with etching the one or more amorphous carbon layers (pg.7, paragraph 0066).

12. Regarding claim 12, Huang et al discloses wherein the hydrocarbon compound has the general formula C_xH_y , wherein x has a range of 2 to 4 and y has a range of 2 to 10 (pg.6, paragraph 0057).

13. Regarding claim 13, Huang et al discloses wherein the one or more hydrocarbon compounds are selected from the group consisting of propylene (C_3H_6), propyne (C_3H_4), propane (C_3H_8), butane (C_4H_{10}), butylene (C_4H_8), butadiene (C_4H_6), acetylene (C_2H_2), and combinations thereof (pg.5, paragraph 0054).

14. Regarding claim 14, Huang et al discloses wherein the generating the plasma comprises applying a first RF power at a first frequency and applying a second RF power at a second frequency less than the first frequency (pg.5, paragraph 0051).

15. Regarding claim 16, Huang et al discloses wherein the ratio of second RF power to first RF power is less than about 0.6:1 (pg.5, paragraph 0051).

16. Regarding claim 17, Huang et al discloses wherein at least one of the one or more amorphous carbon layers comprise an anti-reflective coating (pg.3, paragraph 0023).

17. Regarding claim 18, Huang et al discloses wherein the anti-reflective coating is a material selected from the group of silicon nitride, silicon carbide, carbon-doped silicon oxide, amorphous carbon, and combinations thereof (pg.2, paragraph 0014).

18. Regarding claim 19, Huang et al discloses further comprising depositing a barrier layer prior to depositing the dielectric material (pg.2, paragraph 0014).

19. Regarding claim 20, Huang et al discloses further comprising removing the resist material prior to etching feature definitions in the dielectric layer (pg.2, paragraph 0011).

20. Regarding claim 21, Huang et al discloses wherein the etch selectivity of amorphous carbon to the dielectric material is greater than about 1:10 (pg.5, paragraph 0054).

21. Regarding claim 22, Huang et al discloses a method for processing a substrate, comprising: depositing one or more dielectric layers on a substrate surface, wherein the one or more dielectric layers comprise silicon, oxygen, and carbon and has a dielectric constant of about 3 or less (pg.2, paragraph 0014); forming one or more amorphous carbon layers consisting essentially of hydrogen and carbon on the one or more dielectric layers by a process comprising (pg.3, paragraph 0020): introducing a processing gas comprising one or more hydrocarbon compounds without containing silicon and an argon carrier gas (pg.4, paragraph 0048); generating a plasma of the

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processing gas by applying power from a dual-frequency RF source (pg.5, paragraph 0051); defining a pattern in at least one region of the one or more amorphous carbon layers (pg.4, paragraph 0048); forming feature definitions in the one or more dielectric layers by the pattern formed in the at least one region of the one or more amorphous carbon layers (Figure 4C, reference 416); and depositing one or more conductive materials in the feature definitions (Figure 4C, reference 418).

22. Regarding claim 23, Huang et al discloses further comprising removing the one or more amorphous carbon layers by exposing the one or more amorphous carbon layers to a plasma of a hydrogen-containing gas prior to depositing one or more conductive materials in the feature definitions (pg.5, paragraph 0054).

23. Regarding claim 24, Huang et al discloses wherein the hydrogen-containing gas comprises a gas selected from the group of hydrogen, ammonia, water vapor, and combinations thereof (pg.5, paragraph 0054).

24. Regarding claim 26, Huang et al discloses polishing the one or more conductive materials and stopping on the one or more amorphous carbon layers (pg.2, paragraph 0015); and removing the one or more amorphous carbon layers by exposing the one or more amorphous carbon layers to a plasma of a hydrogen-containing gas (pg.5, paragraph 0054).

25. Regarding claim 27, Huang et al discloses depositing an anti-reflective coating on the one or more amorphous carbon layers; and patterning resist material on the anti-reflective coating; and etching the anti-reflective coating prior to or concurrent with etching the one or more amorphous carbon layers (pg.3, paragraph 0023).

26. Regarding claim 28, Huang et al discloses wherein the hydrocarbon compound has the general formula C_xH_y , wherein x has a range of 2 to 4 and y has a range of 2 to 10 (pg.5, paragraph 0054).

27. Regarding claim 29, Huang et al discloses wherein the one or more hydrocarbon compounds are selected from the group consisting of propylene (C_3H_6), propyne (C_3H_4), propane (C_3H_8), butane (C_4H_{10}), butylene (C_4H_8), butadiene (C_4H_6), acetylene (C_2H_2), and combinations thereof (pg.5, paragraph 0054).

28. Regarding claim 30, Huang et al discloses wherein the one or more hydrocarbon compounds further comprises one or more fluorinated derivatives of the one or more hydrocarbon compounds (pg.5, paragraph 0054).

29. Regarding claim 31, Huang et al discloses wherein the generating the plasma comprises applying a first RF power at a first frequency and applying a second RF power at a second frequency less than the first frequency (pg.5, paragraph 0051).

30. Regarding claim 33, Huang et al discloses wherein the ratio of second RF power to first RF power is less than about 0.6:1 (pg.5, paragraph 0051).

31. Regarding claim 34, Huang et al discloses wherein the anti-reflective coating is a material selected from the group of silicon nitride, silicon carbide, carbon-doped silicon oxide, amorphous carbon, and combinations thereof (pg.2, paragraph 0014).

32. Regarding claim 35, Huang et al discloses further comprising depositing a barrier layer prior to depositing the at least one dielectric material (pg.2, paragraph 0014).

33. Regarding claim 36, Huang et al discloses wherein the etch selectivity of

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amorphous carbon to the dielectric material is greater than about 1:10 (pg.5, paragraph 0054).

34. Regarding claim 37, Schmitt et al discloses wherein at least one of the one or more amorphous carbon layers comprise an anti-reflective coating (Figure 12A, reference 1228).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7, 15 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang et al (US 2004/0072430 A1).

35. Regarding claims 7, 15 and 32, Huang et al discloses generating plasma through the dual frequency (pg.5, paragraph 0051) however, Huang et al does not disclose the specified frequencies applied to the RF power supply.

It is obvious, at the time the invention was made, for one having ordinary skill in the art, to apply a first RF power between at a first frequency between about 10 MHz and about 30 MHz and apply a second RF power at a second frequency between about 100 kHz and about 500 KHz, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the "optimum range" involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (1955).

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Huang et al (US 2004/0072430 A1).

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36. Regarding claim 25, Huang et al discloses wherein plasma is generated by applying power (pg.5, paragraph 0051) however, Huang et al does not disclose the specified power level.

It is obvious, at the time the invention was made, for one having ordinary skill in the art, to apply a power level between about 0.15 watts/cm.² and about 5 watts/cm.², since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the “optimum range” involves only routine skill in the art. *In re Aller*, 105 USPQ 233 (1955).

Conclusion

37. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica D. Harrison whose telephone number is 571-272-1959. The examiner can normally be reached on M-F 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Monica D. Harrison
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mdh
July 7, 2006


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